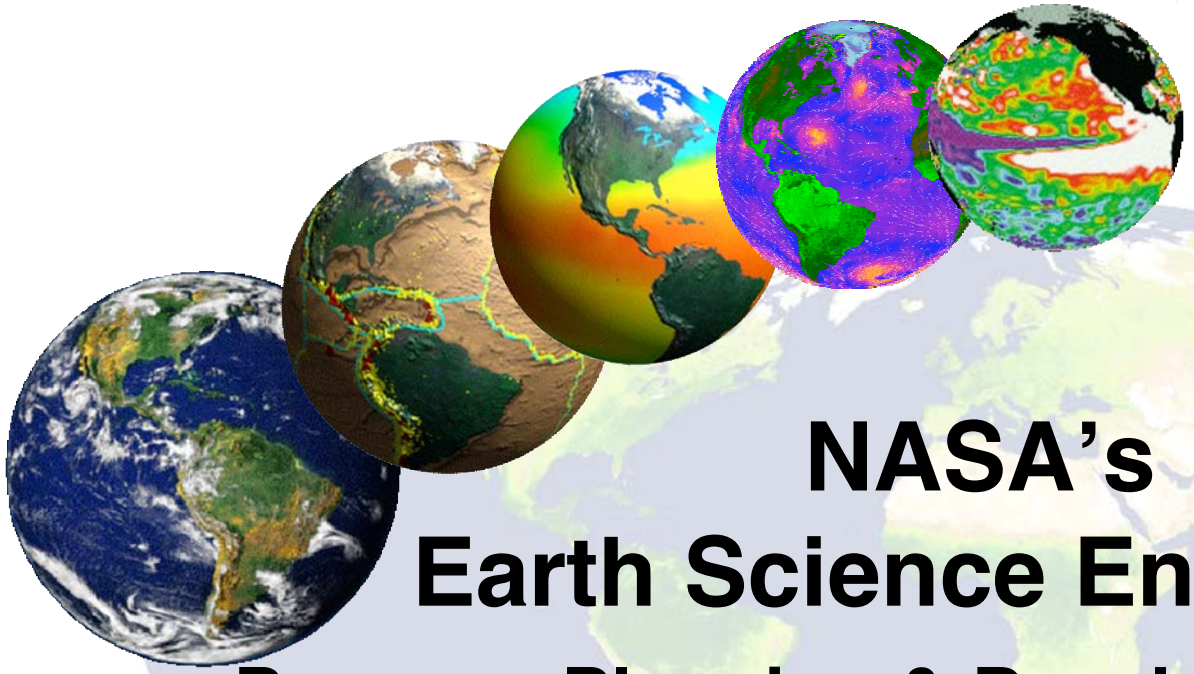


# NASA's Earth Science Enterprise

## Program Planning & Development Division

**Douglas McCuistion,**
**Division Director,**

July 16, 2003

# Overview

- Space Segment Programs in three phases
  - Operation
  - Development
  - Formulation
- Information Systems
  - Earth Science Data Information System (ESDIS)
  - Strategic Evolution of Earth science Data Systems (SEEDS)
- Technology Development and Infusion
  - Earth Science Technology Office (ESTO)

# Space Segment

# Space Segment Progress

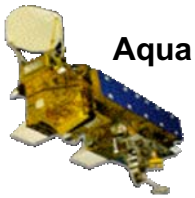
- Completing deployment of the first series of EOS
- Securing the balance of follow-on missions in the FY04-FY05 budget processes
- Transitioning mature measurements to operational systems
- Formation flying of satellites to enhance their scientific productivity

# ESE Current Missions in Orbit

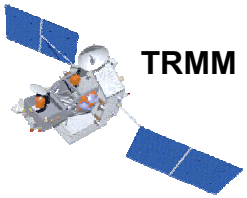
*The Earth Observing System -- systematic measurement of interactions among land, oceans, atmosphere, ice & life*

*Exploratory missions to probe key Earth system processes globally for the first time*

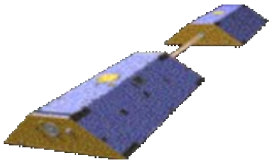
Landsat



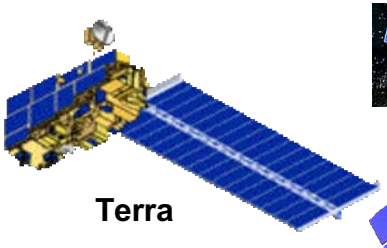
Aqua



TRMM

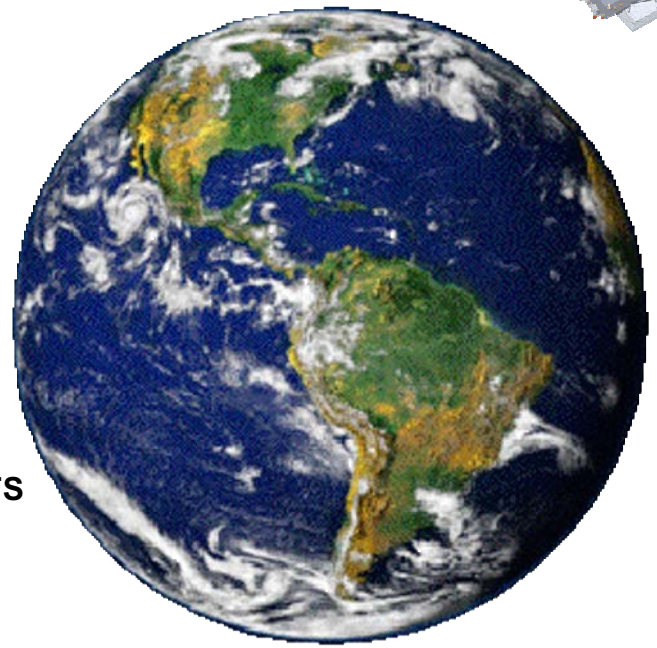


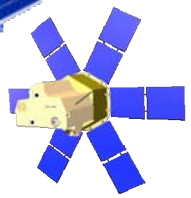
GRACE



Terra

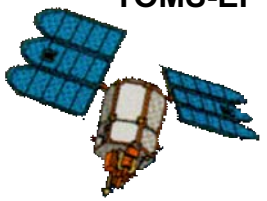
Jason





SORCE

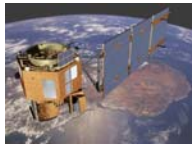
TOPEX/ Poseidon



TOMS-EP

ICESat

SeaWiFS



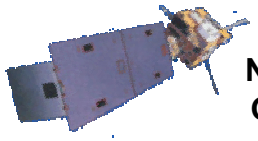
EO-1: ALI & Hyperion

QuikScat

ERBS

ACRIMSAT

*Operational precursor / Technology demos*



NOAA/ GOES

*Operational weather services missions with NOAA*

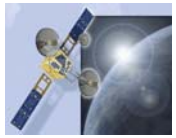
NOAA/ POES

# ESE Missions in Formulation & Development

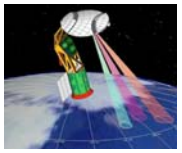
*Next generation systematic measurement missions to extend / enhance the record of science-quality global change data.*

**Aerosol Mission**

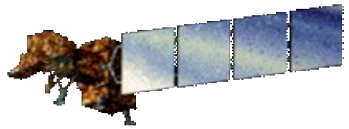
**Global Precipitation Measurement**



**EO-3: GIFTS**



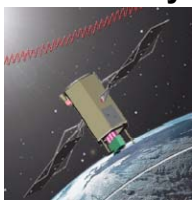
**Aquarius**



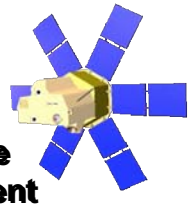
**Landsat Data Continuity Mission**

**Ocean Surface Winds**

**Orbiting Carbon Observatory**



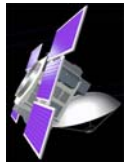
**Calipso**



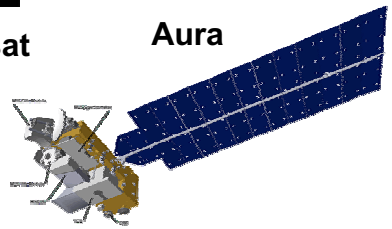
**Solar Irradiance Measurement**

**Total Column Ozone**

**Ocean Surface Topography Mission**



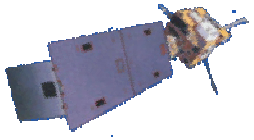
**Cloudsat**



**Aura**

*Research missions to probe key Earth system processes globally for the first time*

**NPOESS Preparatory Project**



**NOAA/GOES N-Q,-R**

**NOAA N-N', NPOESS**

*Operational weather services missions with NOAA/DOD*

# Space Segment Challenges

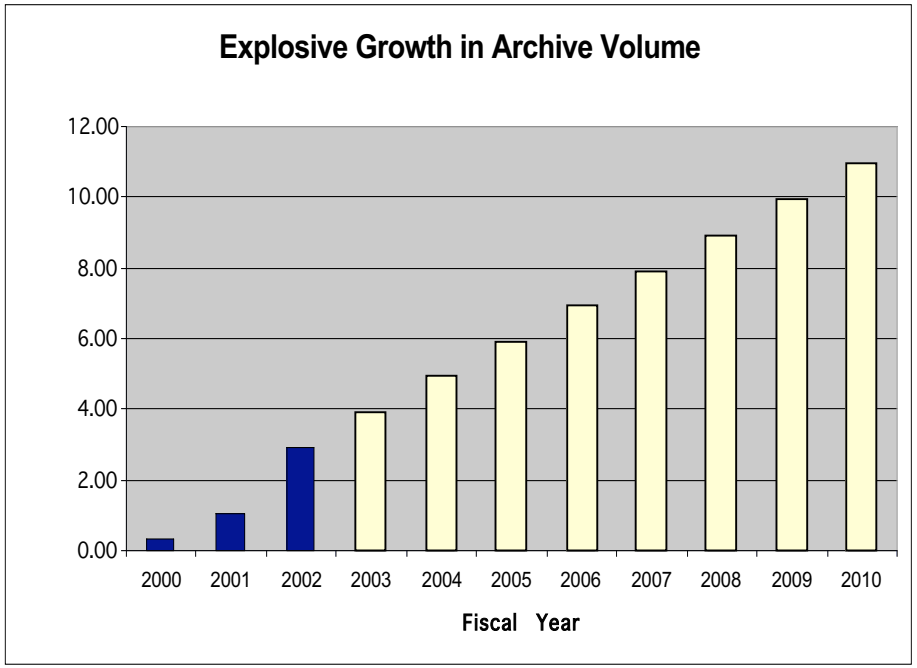
- Moving from mission data sets to climate data sets, achieving continuity and calibration across satellites and technologies
- Expanding opportunities for new observing capabilities
- Balancing data continuity from extended missions against:
  - risks of re-entry
  - deployment of new missions

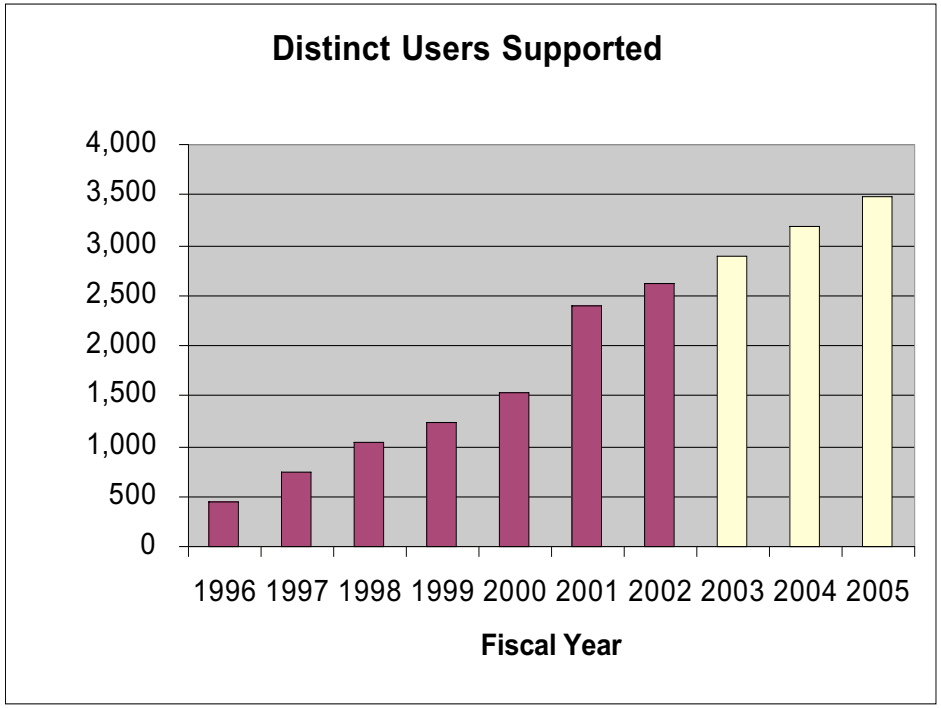
# Information Systems

# EOSDIS: the world's largest "e-science" system for environmental research

Ingesting, processing, and archiving an unprecedented volume of climate and Earth science data (currently ~3TB/day).

We are benchmarking capabilities and processes for handling the capacities for future operational needs (e.g., NPOESS).




NASA provides access to Earth system science data, information, and services to millions of unique users.

Over the next decade, ESE will ensure the timely delivery of Earth Science information at an affordable cost by evolving to a more open, distributed set of data systems and service providers.

# Evolution of EOSDIS into the Next Generation DIS

- EOSDIS is an operational data system currently holding over two petabytes of data in its archive.
- Lessons learned from EOSDIS will enable NASA to evolve to the next generation data and information systems while ensuring user access to data and services currently offered.
- NASA's next generation data and information system for science priorities over the next decade will build upon its legacy systems by taking advantage of advances in:
  - data storage
  - networking
  - computational technologies.
- The Strategic Evolution of ESE Data Systems (SEEDS) strategy provides the framework for incorporating heritage data and information system components into an emerging heterogeneous and flexible data system.

# The Strategic Evolution of ESE Data Systems (SEEDS)

- SEEDS Mission: To establish an evolution strategy and coordinating activities to assure the continued effectiveness of ESE data management systems and services.
- SEEDS Objectives:
  - Ensure timely delivery of Earth Science information at an affordable cost.
  - Maximize availability and utility of ESE products to enable improved prediction of climate, weather, and natural hazards.
  - Engage the community on data management issues, objectives, and solutions.
  - Enable the development of flexible systems to readily accommodate evolving products and services.
- The recent Research, Application, and Education Solutions Network (REASoN) cooperative agreement is the first step in the implementation of the SEEDS framework.

# Information System Challenges

- Development & exploitation of heterogeneous information systems
  - Enable flexibility within data systems to adapt to new data stream(s) or to changes in current processing streams
  - Create *measurement* oriented data systems within the SEEDS interoperable framework that will help guide the flow of information and services and improve performance and access.
  - SEEDS as fabric: information web to mesh
- What & how does EOSDIS evolve into next generation distributed architecture
  - Identify and create interfaces that facilitate the flow of data to modeling efforts (e.g. carbon assimilation) - "one size does not fit all". Enable seamless 'hooks' into data mining and high performance computing environments.
  - Leverage internet, plug & play

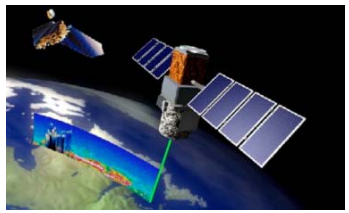
# Technology

# ESE Technology

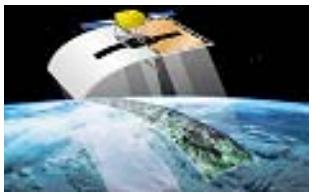
- Flexible science-driven technology strategy
  - Measurements enabled by technology
  - Managed by Earth Science Technology Office (ESTO)
- Employing competitive solicitations to capture best ideas
- ESE Technology Development areas
  - Advanced instruments and instrument components
  - Information and telecommunications systems technology

# Technology Challenges: balancing mid-term and long-term

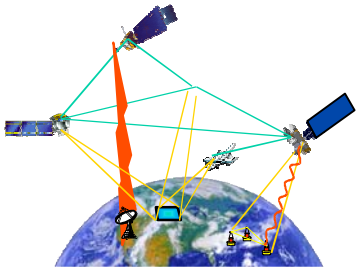
- Laser/Lidar technology to enable 3-D characterization of the planet



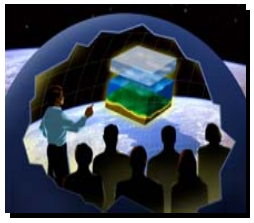
- Large Deployables to enable future weather, climate, and natural hazards measurements



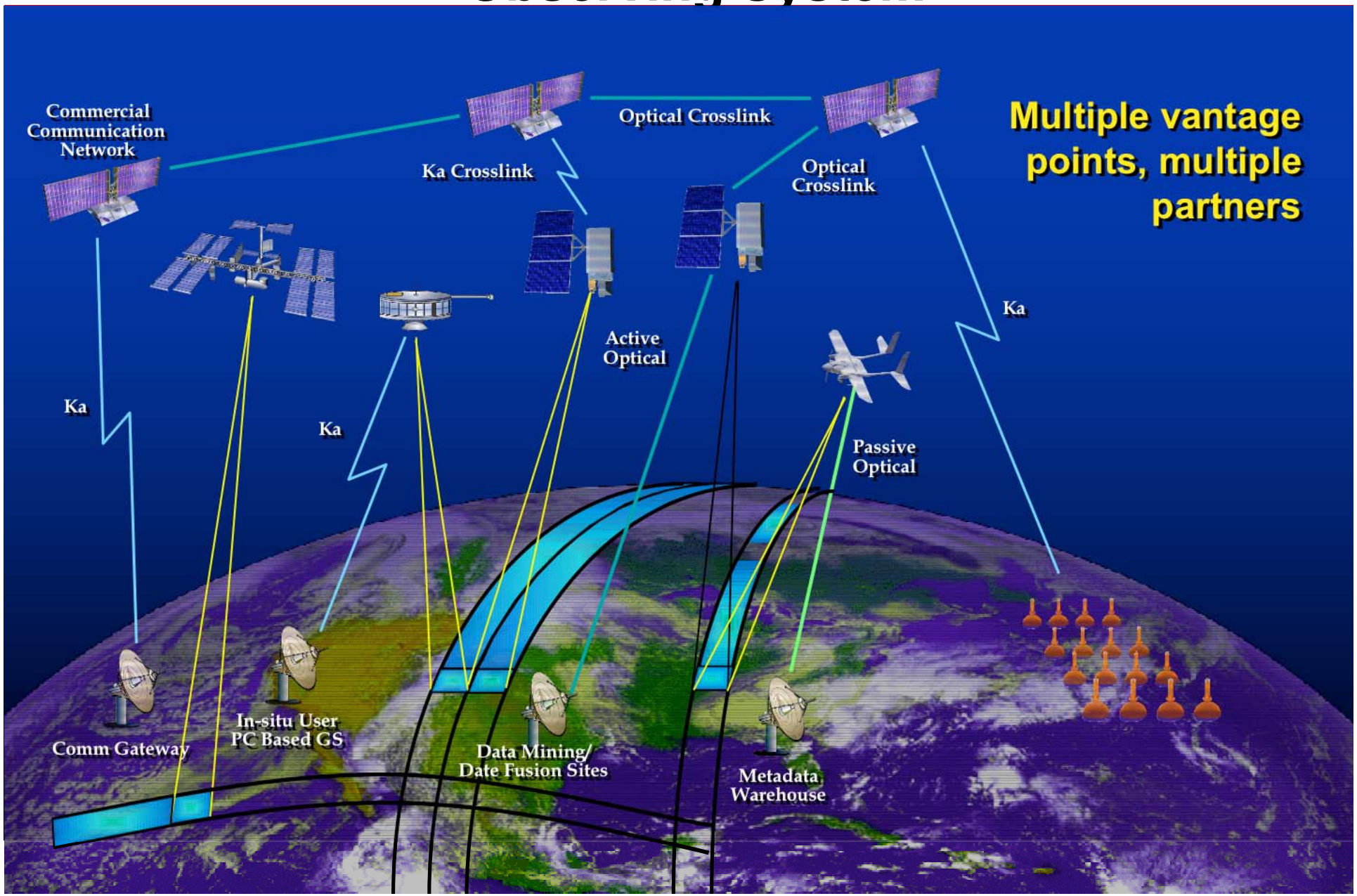
- Intelligent Distributed Systems using optical communication, on-board reprogrammable processors, autonomous network control, data compression, high density storage



- Information Knowledge Capture through 3-D Visualization, holographic memory and seamlessly linked models.



# Our Vision -- An Integrated Global Observing System

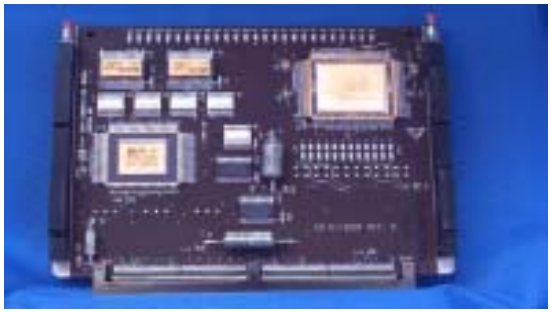


# Backup

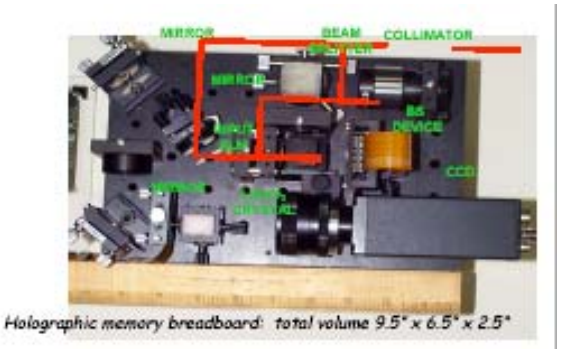
# Solid Earth Technology

Lightweight inflation deployed 3x5m
Membrane SAR antenna, < 2kg/m2
- Wendy Edelstein, JPL

Loss-less compression board:
Reprogrammable Data Path Processor
ASIC component – complex algorithms
In real time at high speed with low power
with on-board SAR data applications
- Pen-Shu Yeh, GSFC

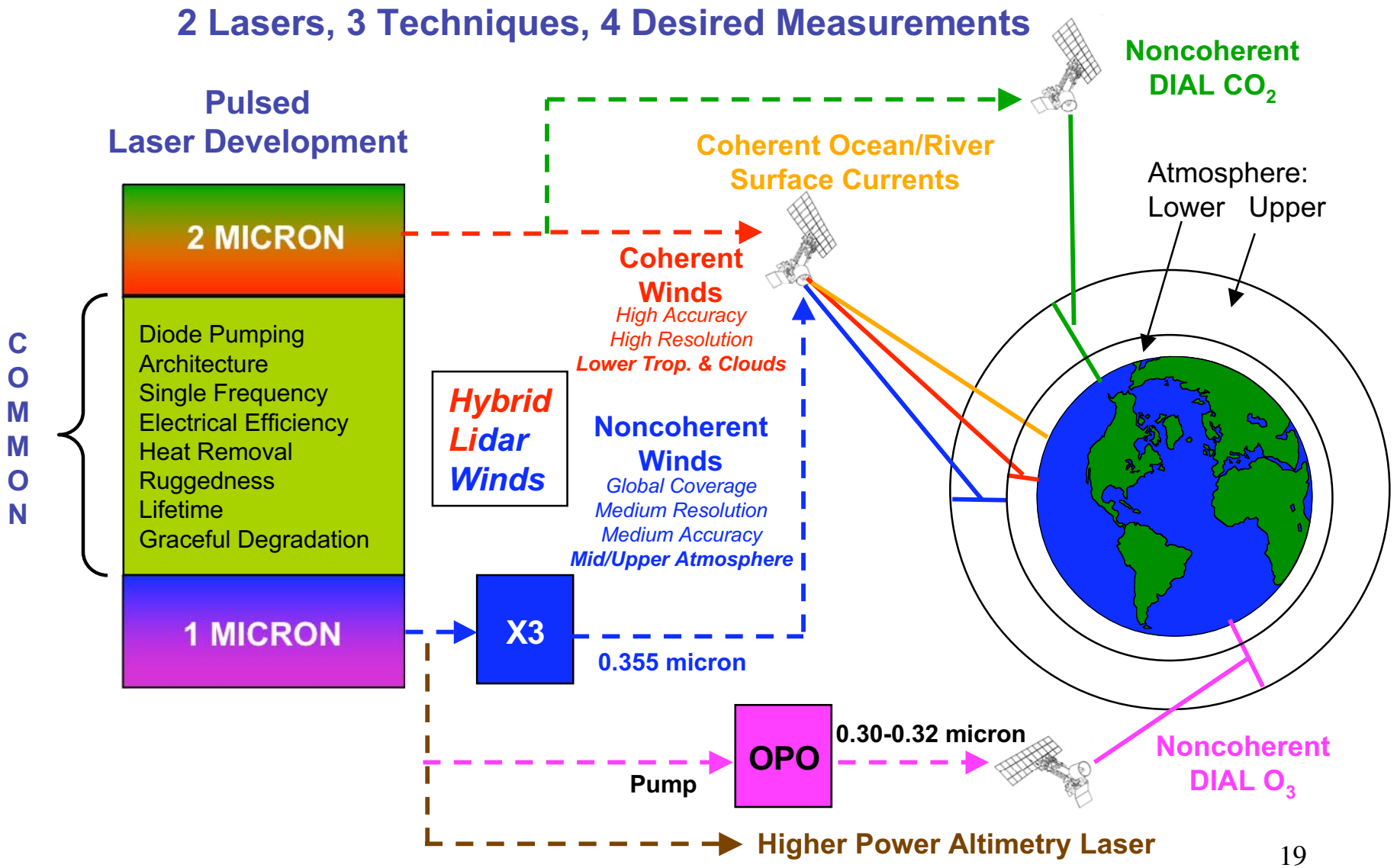


Holographic memory technology to enable
real-time mass data storage/retrieval in space
Environment, demonstrated 10 Gb/module
Storage and random data transfer rate up to
1Gb/sec
- Tien-Hsin Choo, JPL



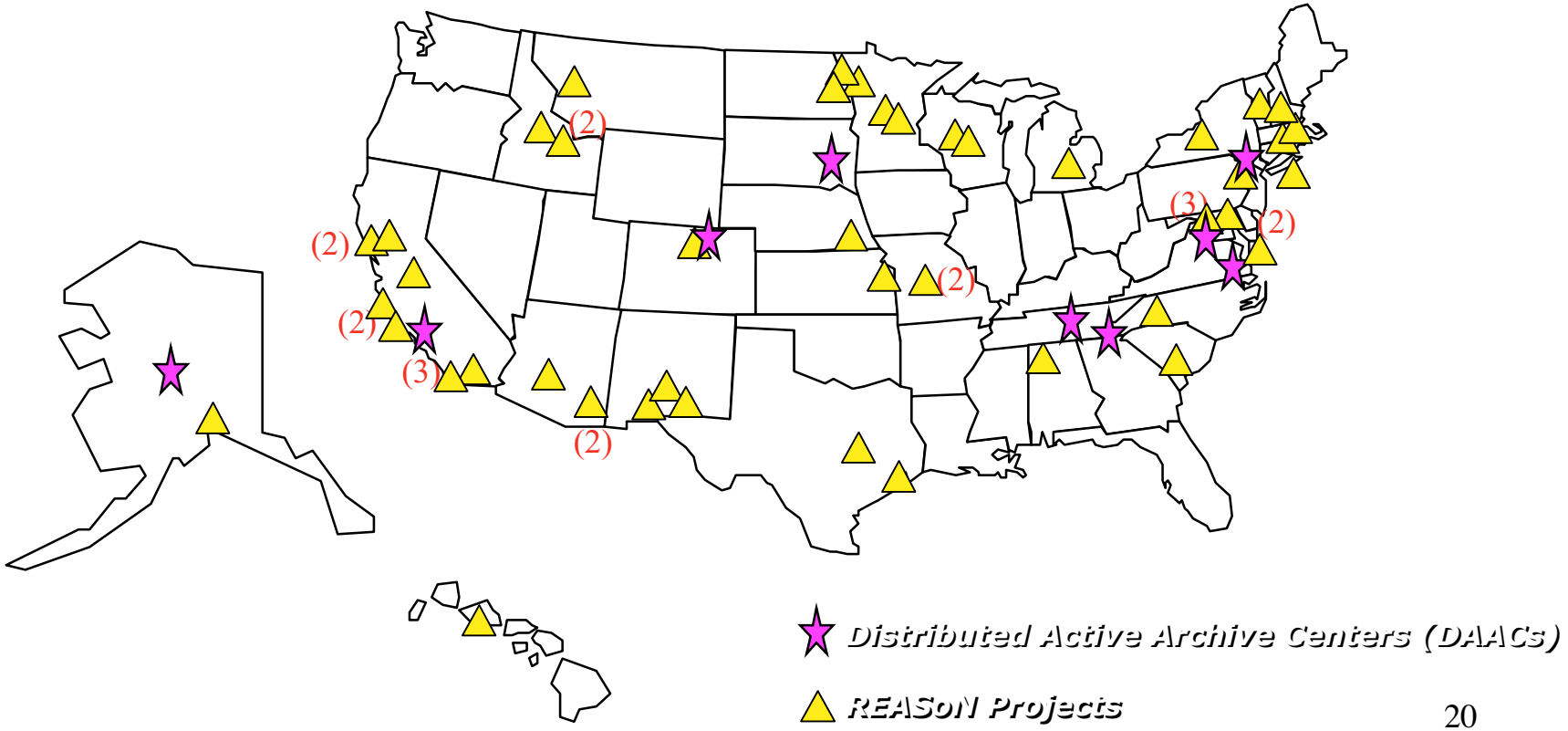
Holographic memory breadboard: total volume 9.5" x 6.5" x 2.5"

# Laser Technology

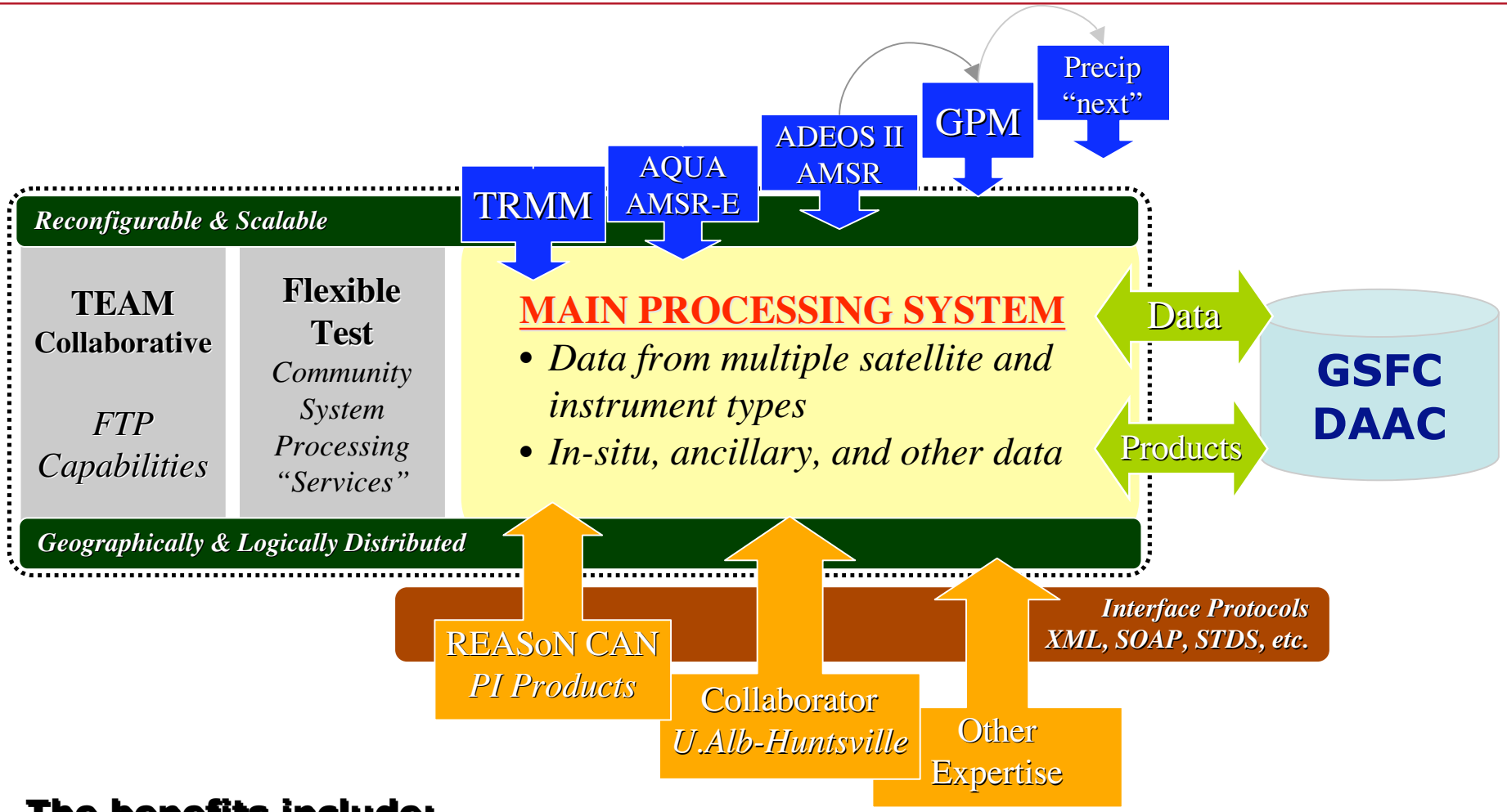


# NASA's ESE Data Center Locations

- **A total of 68 widely distributed data centers (some of which are at the same location).**
- **ESE has recently updated our peer reviewed data and information producing centers through the Research, Education and Applications, Solutions Network Cooperative Agreement Notice (REASoN CAN) for development of next-generation architectures.**



# A SEEDS Prototype Measurement System: The Precipitation Processing System




**The benefits include:**

- **Processing embedded within the science focus areas**
- **Community, participation, consensus and community services**
- **Allows processing capabilities to be closer to the science teams**
- **Engage expertise through peer review selection**